Space Weather Technical Forecast

Issued on Tuesday, 15 March 2022 at 12:03 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares. Chance of Active fluence by Days 2-4 (16-18 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours with several C-Class flares observed. There are currently four sunspot regions on the visible disc. The largest and most complex of these is AR2965 which was the origin of most of the flares. AR2960 is large but stable, and will be rotating off the Earth-side of the disc towards the end of Day 1 (15 Mar). The other two regions are both small and simple. There is one slow weak CME observed on 13 March which may give a glancing blow at Earth on day 3 (17th). No other Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, showed the effects of a CME which arrived at 13/1014 UTC. Solar wind speeds have been mostly slightly elevated through. Density remained at mostly near average levels, peaking at 15ppcc at 14/1218 UTC .The IMF, Bt, remained at mainly Moderate levels. The north-south component, Bz, was strong at first becoming Weak to Moderate. Phi angle was negative (towards the sun). Geomagnetic activity was Quiet (Kp1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was at background levels throughout with a very slight increase noted from 14/2200 UTC. The high energy electron flux (greater than 2 MeV) has been moderate to background levels. The 24-hour integrated electron fluence was below the Active (1e8 integrated pfu) threshold. Observed fluence at 15/0000 UTC was 1.55e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, perhaps Moderate given a chance of M-class flares. The risk of M-flares mainly comes from AR2965.

Solar Wind / Geomagnetic Activity: There is a risk of further periods of negative Bz, with a slight chance of a glancing blow from a weak CME on Day 3 (17 Mar). No coronal hole effects are currently expected during this period. Geomagnetic activity is likely to be predominantly Quiet, with the greatest chance of any significant increases in activity to Active (Kp4) if we do see the weak CME on Day 3 (17 Mar).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels, although there is just a very slight chance of an increase in response to any larger flares that may occur.
The high energy (greater than 2 MeV) electron flux is currently at background levels. Some charging may have occurred from the recent CME, so a rise in electron levels is possible from Day 1 (15 Mar) onwards, with some uncertainty as to the level of any charging. The electron

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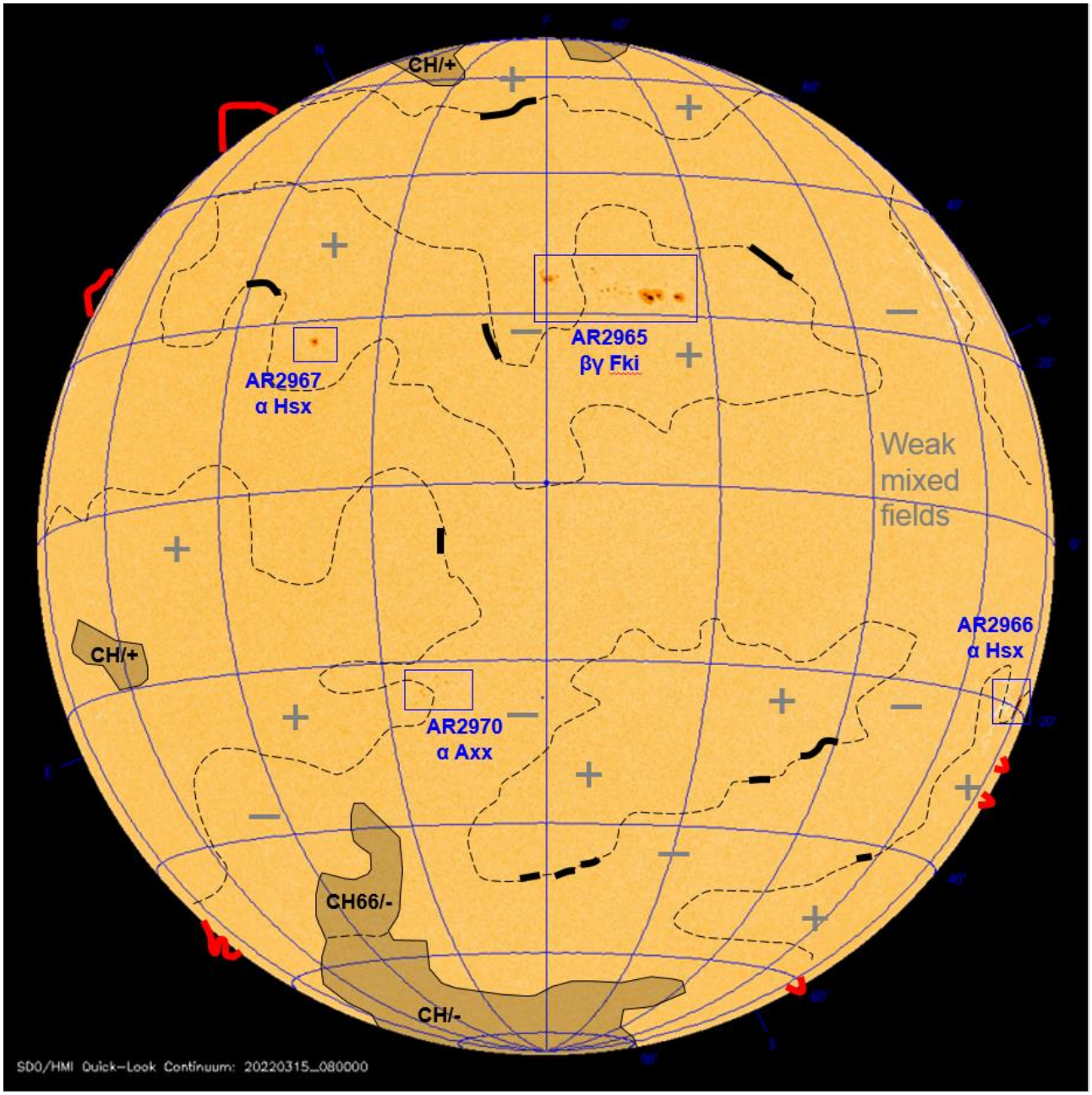
fluence is likely to follow a rising trend if we see an electron response, with a chance of reaching the Active (1e8 integrated pfu) threshold on Days 2-4 (16-18 Mar), although some uncertainty from Day 3 (17 Mar) if we do see the arrival of a weak CME.

Figure 1. Solar Analysis Valid 0800UTC, 15 March 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

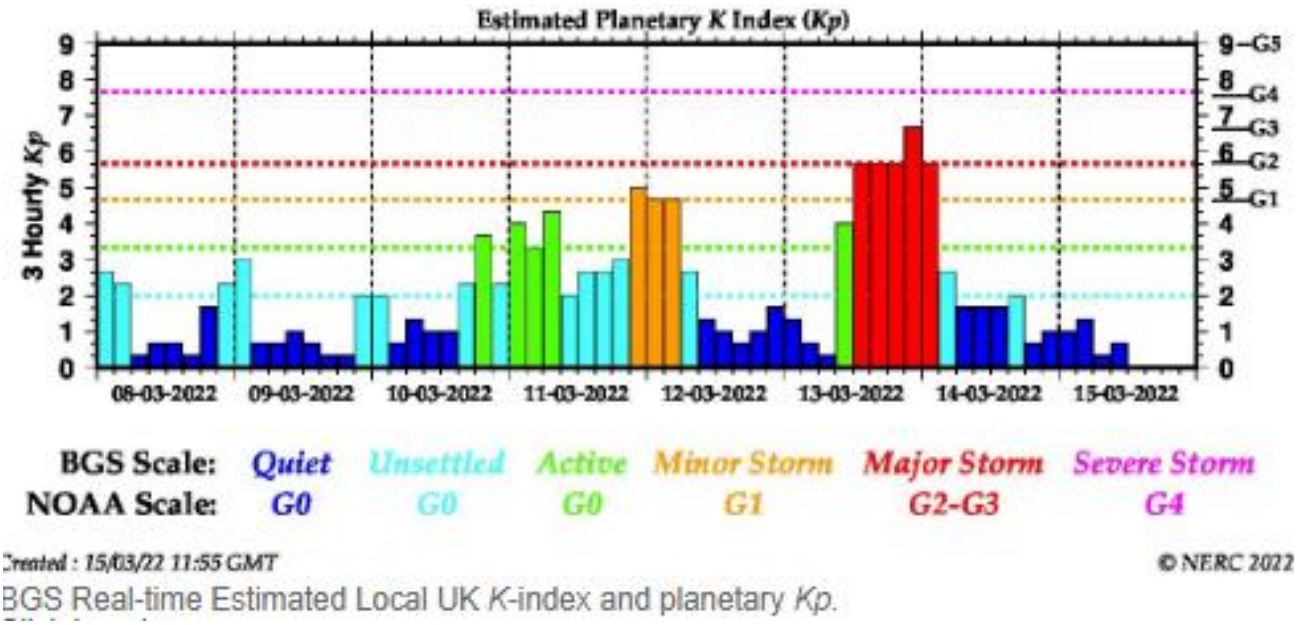
Solar wind speeds are currently slightly elevated. There is a slight chance of a glancing blow from a weak CME on Day 3 (17 Mar), but the bulk of the ejecta is expected to pass below Earth. No coronal hole effects are currently expected during this period. Geomagnetic activity is likely to be predominantly Quiet, with the greatest chance of any significant increases in activity to Active (Kp4) if we do see the weak CME on Day 3 (17 Mar) and this is reflected in the table of probabilities.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS plot of recent geomagnetic activity, with Quiet conditions now.



BGS Real-time Estimated Local UK *K*-index and planetary *Kp*.

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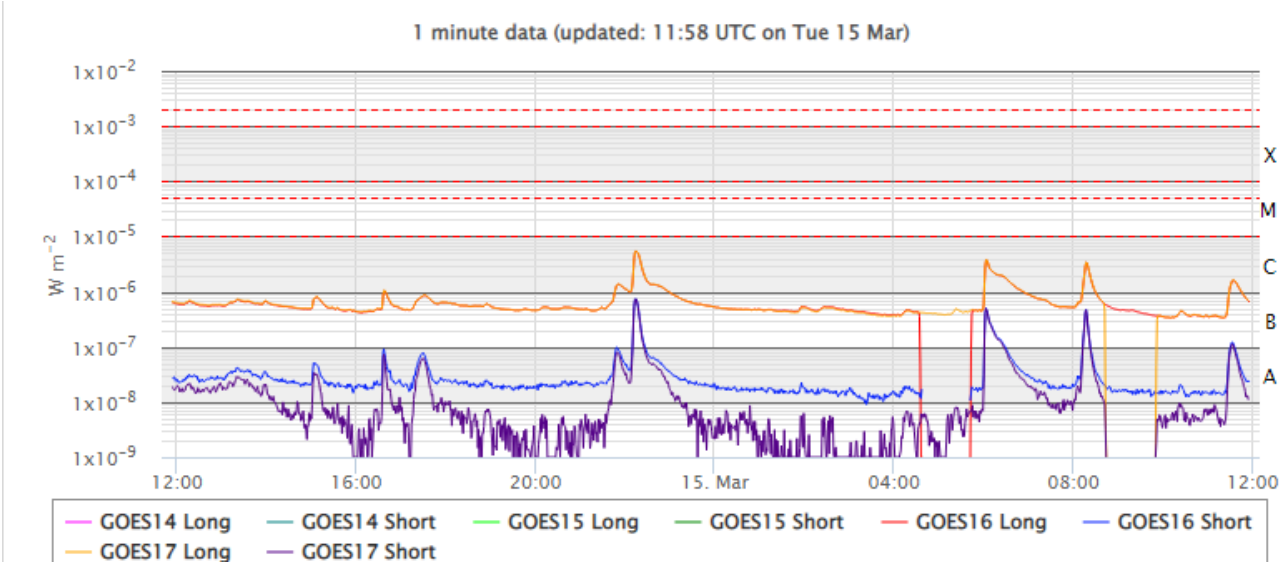
Radio Blackouts - X-Ray Flares:
There are currently four numbered sunspot regions on the visible disc, with Low solar activity. Several C-class flares have originated from the largest region, AR2965. This region is near centre disc in the northern hemisphere, classified Fki/Beta-gamma, with its intermediate spots displaying some rudimentary penumbra. AR2960 is a large Hhx/Alpha spot in the far southwest and approaching the limb but has remained stable, with no flare activity observed. The remaining two spots are both small and simple unipolar regions.
Activity is expected to be Low, with a chance of increasing to Moderate from any M-flares that occur over the coming forecast period, with the main risk from AR2965.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: X-ray lux at GEO with several C-class flares from AR2965.



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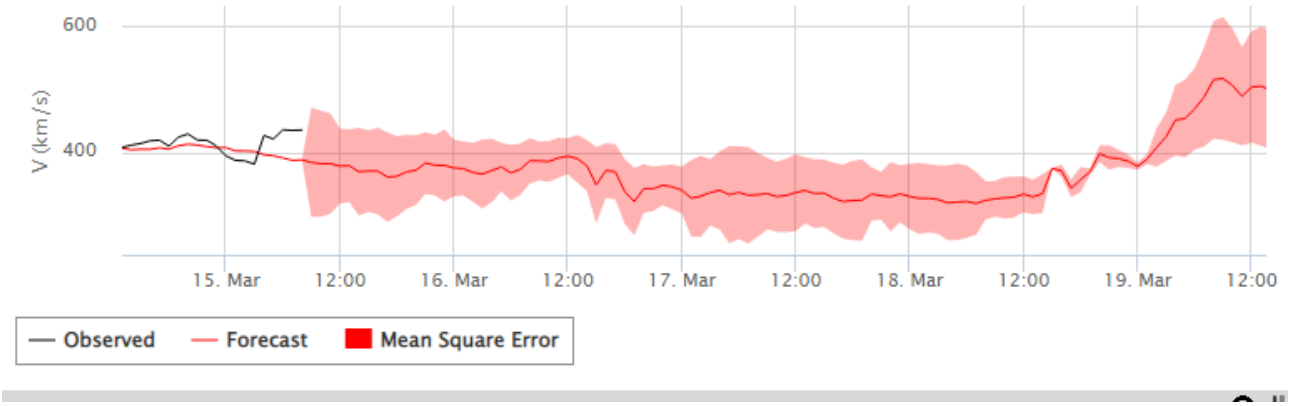
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (10MeV) measured at GOES 16 is currently at background levels. There is a slight chance of an S1/Minor radiation storm in the event of larger flares occurring, mainly from AR2965.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office SWPM output indicating next increase during the weekend.



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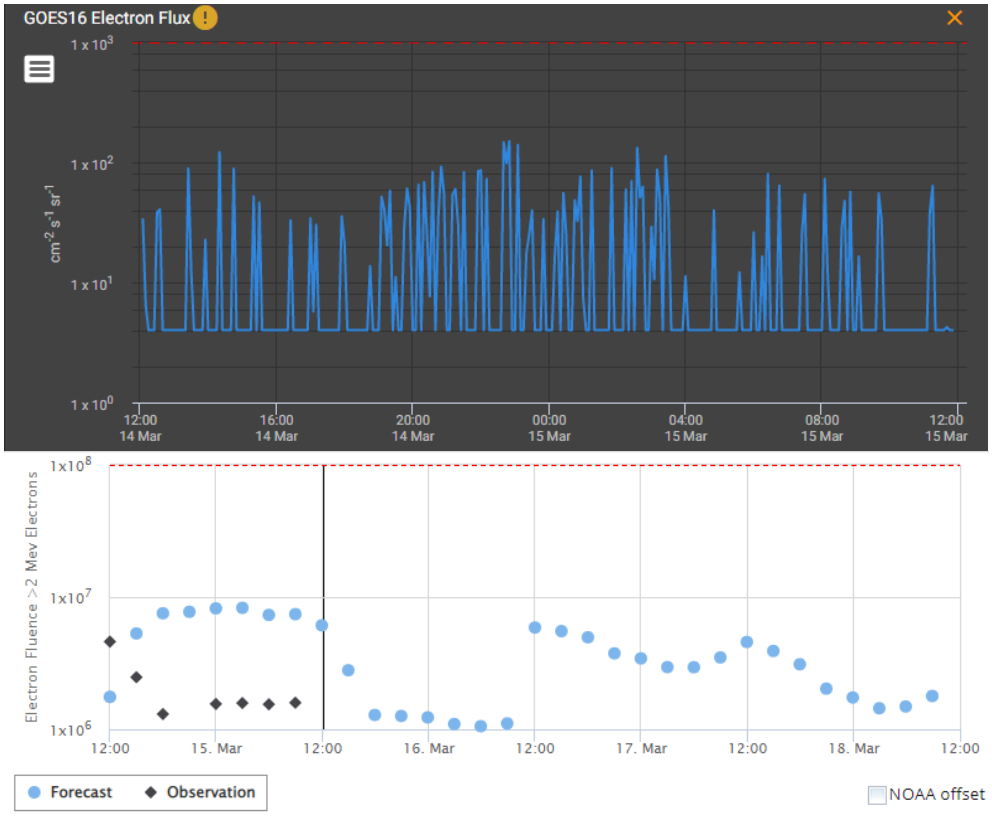
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at background levels. The recent CME arrival has suppressed electron flux levels, but some charging may have occurred from the higher wind speeds, although these higher wind speeds were relatively short lived. Therefore a rise in electron levels is possible from Day 1 (15 Mar) onwards, although some uncertainty remains as to the level of charging we may have experienced.

The associated 24 hour electron fluence is likely to follow a rising trend if we see an electron response to this CME, but currently confidence is low as to whether it is likely to reach the Active (1e8 integrated pfu) threshold, with a chance on Days 2-4 (16-18 Mar), but with some uncertainty due to the potential glancing blow from a weak CME on Day 3 (17 Mar).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	30	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux and Met Office REFM output.



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